GROUNDWATER DISCHARGE

UNIVERSITY OF CALGARY

GROUNDWATER CONNECTION FACT SHEET SERIES

DISCHARGE:

- **The movement of groundwater from the subsurface to the surface**

PERMEABILITY:

- **The ability of a material to allow the passage of liquid through it.**

BASEFLOW:

- **The flow in a stream during dry periods.**

AQUATIC ECOSYSTEM:

- **An ecosystem closely associated with and dependent on a body of water.**

What is groundwater discharge?

Groundwater discharge is the term used to describe the movement of groundwater from the subsurface to the surface. There is natural discharge which occurs into lakes, streams and springs as well as human discharge, which is generally referred to as pumping. The natural discharge is controlled by the topography and geology, with groundwater discharging in topographically low areas (for example, valley floors) containing higher permeability sandstone layers or gravels. When a sandstone unit of the Paskapoo formation is visible, it is called an outcrop and can be associated with groundwater discharge in the form of springs.

Why is groundwater discharge important?

It has been found that in West Nose Creek watershed (in Rocky View County), the majority of baseflow in the streams is provided by the groundwater discharge from springs. The term “baseflow” refers to the flow in streams during dry periods. This groundwater-surface water interaction allows water to flow in the stream during the summer months. Baseflow is critical for maintaining habitat and nutrients to the aquatic ecosystem. In addition, some landowners rely on springs for household and/or agricultural uses.

How does groundwater discharge?

There are various processes which naturally discharge groundwater. The first is along the stream when the channel bed is located at the water table (Figure 1). The groundwater discharges into the stream to provide baseflow during hot summer months. This type of discharge is generally continuous along the length of the channel bed as long as it is at the water table.

Answer continues on Page 2 →

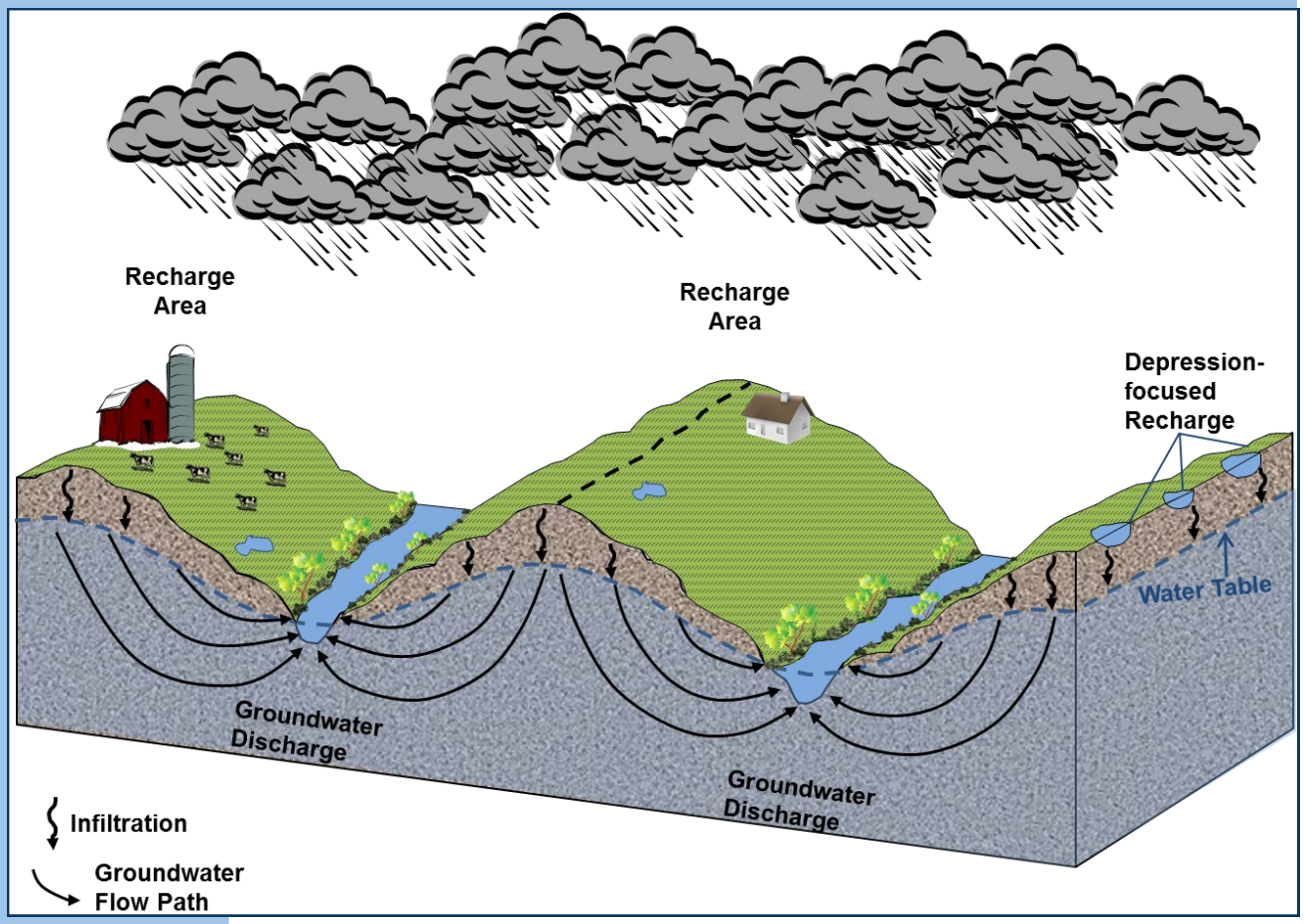

Figure 1: Idealized groundwater discharge. Water flows from high to low areas

How does groundwater discharge?

Groundwater also discharges through springs, whereby groundwater moves laterally through permeable sandstone and emerges at an outcrop (Figure 2a). Paskapoo sandstone outcrops occur when the overlying material, generally glacial till, has eroded away, exposing the sandstone unit. Generally, springs discharge from the upper sandstone unit of the Paskapoo; however, groundwater within deeper sandstone units may also discharge as a spring. Spring discharge can also occur through the overlying gravels before entering the stream (Figure 2b). Water is able to move through the gravels due to their high permeability, allowing water to easily flow through. This discharge would not be visible on the surface, but would still be a point source discharge instead of continuous along the bed of the stream channel. In the City of Calgary, springs can be found discharging into the Bow River. A number of springs in Bowmont Park discharge from gravels and then flow on the surface towards the Bpw River. Therefore, the spring outlet appears more like the one illustrated in Figure 2a, but without a visible sandstone unit.

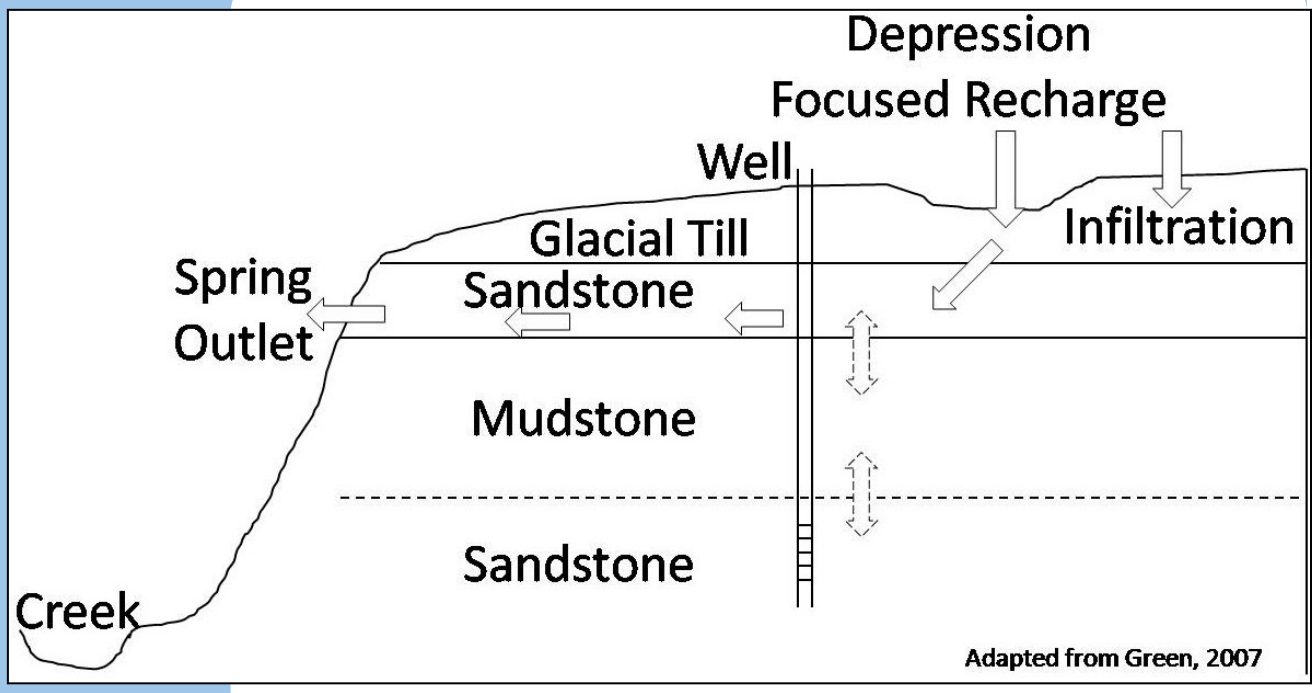

Figure 2a: Typical geological profile of spring outlet from sandstone layer exposed at the edge of a stream channel. Solid arrows indicate groundwater flow; dashed arrows indicate flow to deeper geological layers. (Adapted with permission, Green, 2007).

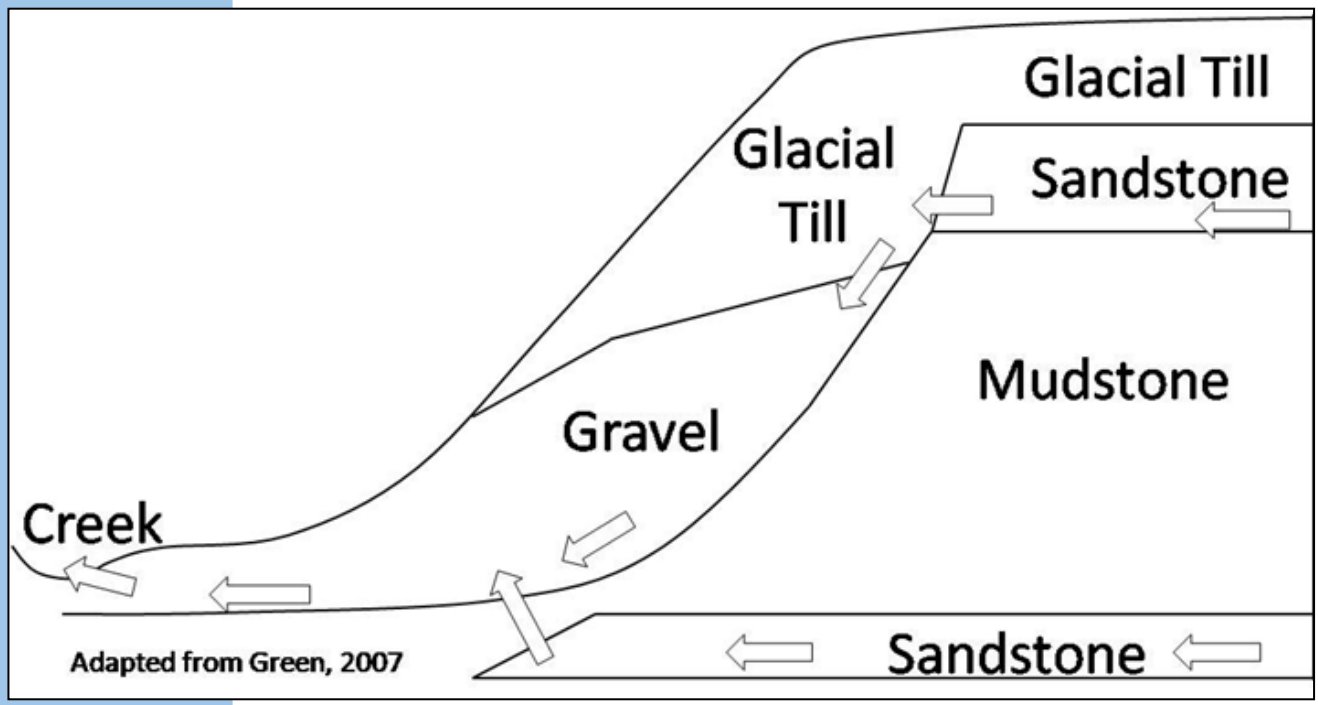

Figure 2b: Alternative geological profile of spring outlet through glacial till and gravel from sandstone layers (Adapted with permission, Green, 2007).

What type of discharge is most common in West Nose Creek?

Both types of springs appear to occur in Rocky View County. However, the majority of springs found in West Nose Creek resemble the process illustrated in Figure 2a, springs discharging from a sandstone unit. In West Nose Creek, research found that groundwater originates from depression focused recharge areas and moves laterally through the more permeable, sandstone layers and emerges at spring outlets. The majority of springs in the watershed originate from the upper sandstone unit (Figure 2a). This was determined in a study examining the groundwater-surface water interactions within the watershed (Green 2007). Since a large number of springs originate from the upper sandstone unit, they can function as an indicator to provide information about the aquifer.

NATURAL DISCHARGE:

1. *Lakes*
2. *Streams*
3. *Springs*

HUMAN DISCHARGE:

1. *Pumping*

Photo Left: A photo of Nathan Green sampling a spring in West Nose Creek for his research.

What is the human impact on groundwater discharge?

The other form of discharge in a watershed occurs when water is pumped for residential, commercial or industrial uses. Groundwater extraction for human use can have significant impacts on groundwater resources. As water is pumped from a well it causes a “drawdown” of the aquifer water level near the well. If there is a surface water body being fed by the aquifer being pumped, the lowering of the water level can cause the stream levels to decline impacting the aquatic ecosystem.

Since the springs are a major contributor to baseflow of the creeks in West Nose Creek watershed, future increases in pumping could impact this vital groundwater-surface water interaction. However, the difference in discharge rates of springs may also be due to the fractures in the bedrock. Therefore, more research needs to be conducted to determine what impacts humans are having on groundwater resources.

REFERENCES

Green, N. 2007. A Hydrogeological Characterization of the Springs in the West Nose Creek Watershed. Unpublished B.Sc. Thesis, University of Calgary: Calgary, Alberta.

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